APPENDIX A.
DECONSTRUCTING SURPLUS ARMY BUILDINGS. A WHITE PAPER

Background.

Army installations are currently removing World War II-era buildings from their real property inventories. These buildings are mostly wood framed structures built in the early 1940s as temporary facilities. Typically, they have remained occupied and have been upgraded several times over the last 60 years. However, they are now functionally obsolete, and further operation and maintenance expenditures cannot be justified. Under the Army's Facility Reduction Program, these surplus buildings are being demolished.

The U. S. Army Engineer Research and Develop Center (ERDC) Construction Engineering Research Laboratory (CERL) is investigating ways toe reduce solid waste on military installations. This paper discusses deconstruction and recycling as an alternative to landfilling construction and demolition (C&D) waste.

The following represents a summary of current Army practices for disposing of these buildings. Information was gathered from personnel involved in removing WWII-era wood buildings at four major Army installations and three installations closed under the Base Realignment and Closure Program. This White Paper includes the following discussions.

A problem statement.
Current Army demolition practices.
The deconstruction industry.
Potential for deconstruction Army buildings.
Obstacles to deconstructing Army buildings.
Conclusions and recommendations.

Problem Statement.

The Army has over 30 million square feet of surplus buildings to remove by Fiscal Year 2005. This will cost roughly $27 million dollars. Some estimates triple that amount if demolition requirements for Army Family Housing, Military Construction, and other major construction programs are included.

However, the initial expense of demolishing buildings is only part of an installation's problem. Installations estimate the life cycle costs of landfill management to be about $30 – 50 per ton, or roughly $1 Million/acre. Demolishing a typical 2-story WWII barracks will generate close to 400 tons of debris.

The solid waste generated from construction and demolition activities now constitutes roughly 85% of some installations' solid waste burdens. Army landfill

capacities are diminishing. Further landfill expansion will be extremely difficult, if possible at all. When on-post landfills are closed, tipping fees at local landfills will add $30 to $90 per ton of debris, not including transportation costs.

The adverse effects of landfilling demolition debris extend beyond Army properties as well. Solid waste is also linked to greenhouse gas. The U.S. Environmental Protection Agency (EPA) has identified solid waste reduction as one of many ways to mitigate global climate change. The manufacture, distribution, and use of products – as well as management of the resulting waste – all result in greenhouse gas emissions. Waste prevention and recycling reduce greenhouse gases associated with these activities by reducing methane emissions, saving energy, and increasing forest carbon sequestration.

EPA has developed the WAste Reduction Model (WARM) to analyze greenhouse gas emissions reductions from several different waste management practices. WARM is available in a Web-based calculator format and as a Microsoft Excel spreadsheet. WARM calculates and totals greenhouse gas emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling. The model calculates in metric tons of carbon equivalent (MTCE) across a wide range of material types that compose municipal solid waste (MSW).

In summary, the solid waste problem attributable to construction and demolition debris is becoming problematic to the Army. Any opportunity to reduce this burden – that is, keep materials out of the landfill -- should be pursued.

Current Demolition Practices.

Typically, WWII-era buildings are demolished under one of two general scenarios, although numerous variations are practiced. Buildings may be demolished to remove them from real property inventory (i.e., Facility Reduction), or to clear a site for new construction. The processes are different for each.

Whether more WWII wood buildings are demolished under the Facility Reduction Program, or as part of a new construction project, depends on the installation. The primary variables are the WWII buildings' location on the installation, new construction programs, and funding availability. Simple observation would suggest most WWII wood buildings are removed under the Facility Reduction Program on most installations.

A third situation, installations under the Base Realignment and Closure (BRAC) procedures, presents a significant requirement for building removal. Under BRAC property transfers, the Army is responsible for removing or remediating an buildings with environmental or physical hazards. Most buildings are eventually transferred. Because the Army does not assume responsibility for removing

these transferred buildings, this is not perceived as an Army problem, but can be a significant barrier to economic development to the receiving organization.

Facility Reduction.

Under a Facility Reduction scenario, buildings are demolished simply to get rid of them and, therefore, avoid further operation and maintenance expenses. Demolition is funded by the installation out of their Operation and Maintenance, Army (OMA) appropriations. The installation's Directorate of Public Works (sometimes organized as the Public Works Business Center) administers this activity. This organization will be referred to as "Public Works" or PW in this paper.

Despite being classified as "surplus," WWII-era buildings are more often than not occupied. The PW Master Planning branch will identify facilities that are ready for demolition once the occupants are relocated, the buildings are vacated, and the appropriate property transfer actions are completed. Typically, this process will vacate buildings in relatively small numbers at any one time. It is unusual that any more than four to six buildings will be vacated at once. The availability of space on the installation, into which occupants can be relocated, dictates the rate at which buildings are vacated. A small group of buildings may be vacated each several weeks, or each five or six months or so. Vacating buildings in large numbers at one time, say 50 to 100, would certainly be the exception.

Once buildings are designated for demolition, PW contracts for demolition services. A common practice is to retain a contractor on a Job Order Contract (JOC), which is an indefinite-delivery type of contract. Awarding a JOC involves a competitive process. But once a JOC has been initiated, PW can assign tasks relatively quickly, as the advertising and bidding requirements have already been satisfied. Demolition tasks can be defined, specified, negotiated, and begun within a couple of weeks. Other types of indefinite-delivery types of contracts are also utilized. As demolition services can be retained quickly and simply under a JOC or similar arrangement, advertising and awarding a contract for demolition services as an independent contract action is generally not done.

Practice among installations varies regarding the removal of asbestos, asbestos-containing materials (ACM), and hazardous materials. In some cases, the PW Environmental Division will contract independently to have these materials removed before demolition. Otherwise, these requirements are included in the demolition contractor's scope of work. The demolition contractor, in turn, will subcontract asbestos, ACM, and hazardous materials removal to qualified firms.

Once buildings are cleared of asbestos, ACM, and hazardous materials, the demolition contractor will terminate utilities at the designated locations, mechanically demolish a building, and crush the debris. The track mounted hydraulic excavator seems to be the equipment of choice at present. Debris is

then loaded into a dump truck and transported to a landfill. Removal of foundations and utilities below grade is typically not required. Concrete foundation walls and floor slabs are broken at grade and loaded into dump trucks. Piers are frequently just extracted intact. Concrete debris is then hauled to a landfill. The site is then graded to drain, seeded, watered, and mulched. A standing building will become a flat, seeded site usually in 3 or 4 days.

To reduce the cost of demolition, the contractor will be allowed to deposit debris in the installation's landfill at no cost. The project specifications frequently go so far as to require ALL debris be deposited in the installation's landfill; removing materials from the installation is prohibited. Asbestos and ACM may or may not be allowed, depending on the installation. Hazardous materials are typically taken to the appropriately classified disposal facility, which is usually located off-site. If, however, an installation no longer operates an active landfill, the contractor must deposit demolition debris in a municipal or commercial landfill at the prevailing tipping fee.

Under a traditional demolition scenario, the cost to demolish a building is roughly $3/SF. Including utilities termination, concrete removal, grading, and seeding, the cost of building removal is typically in the $7-8/SF range, but can vary depending on the location and tipping provisions. Total cost to remove a WWII wood framed building, including asbestos, ACM, and hazardous materials removal is programmed at $9/SF.

In summary, WWII wood buildings can be demolished relative quickly after they are vacated and cleared of asbestos, ACM, and hazardous materials. They are typically demolished in relatively small numbers at any one time, but groups of buildings may be vacated and demolished as frequently as each 2 – 4 weeks. The system of defining demolition tasks under a JOC works well for the purposes, and provides a responsive mechanism for removing surplus buildings.

Salvage or recovering or recycling materials is not considered when demolishing WWII wood buildings. Typically, the PW maintenance shops will be given the opportunity to remove items for future repair or replacement requirements. These items generally include the more expensive mechanical and electrical components that are relatively new and should provide a reasonable service life. However, the ability to maintain extensive stocks is limited. Therefore, only selected items are usually recovered. For all intents and purposes, the building is destined for the landfill.

New Construction.

New construction on Army installations is administered by the Corps of Engineers District serving that installation. WWII buildings may occupy the site on which new facilities will be built. In this case, removal of the buildings typically is included within the construction requirement for the new facility. Construction

is funded through appropriations (not the installation's OMA accounts). Demolition is included within the construction contract amount, and is one activity of the overall construction schedule. Design, contracting, and construction activities are administered by the Corps District, not the installation's PW. It is the installation's responsibility to vacate buildings in time for the construction contractor to demolish them and proceed with construction.

Demolition tasks may be performed by the General Contractor for the new construction project, or subcontracted to a specialty contractor. In either case, the responsibility for performing these services is ultimately the General Contractor's. The physical demolition processes, at least for wood framed buildings, is similar to that described under Facility Reduction, above. Buried utilities and foundations below grade will be removed where they would interfere with the new construction.

Landfilling all debris in the installation's landfill, at no cost to the contractor, is typically specified in the construction contract documents. Again, the rationale is to reduce the cost of construction. Building demolition costs are similar to those described under Facility Reduction, above. However, as demolition is included in the construction contract cost, demolition costs are included as line items in the total project construction estimate. There is no independent funding.

The time taken to demolish a building will be similar to the Facility Reduction scenario. The demolition activities now are not independent but are on the Critical Path of the construction schedule. Any delay in demolition delays the project in total. The General Contractor may add crews or perform activities concurrently to reduce the overall duration of the demolition activity.

Similar to buildings demolished under the Facility Reduction Program, little consideration is given to salvage or materials' recovery. With the exception of some components salvaged by the PW maintenance shops, the building will be demolished and landfilled.

Deconstruction.

A definition for "Deconstruction" should include the following main points:

–Dismantle the building, generally in the reverse order of construction
–Maximize the reuse and recycling of materials
–Ensure a cost-effective and safe process

Thus, deconstruction is a specific approach to remove materials in order to reuse them, in such a way to preserve their integrity and value to the greatest extent possible, in as economical a manner as possible, while not endangering personnel performing the deconstruction. While definitive standard practices have not yet evolved, an overall approach of disassembly in the reverse order of construction applies in the general case. Deconstruction is generally perceived

as manual disassembly of a building, although various combinations of manual and mechanical methods can be applied to improve cost and time performance.

A number of deconstruction projects have been documented and are now recognized as being notable examples. Among them are:

Deconstruction of a house, Portland OR, 1996 *(See http://www.smartgrowth.org/library/waste_mgmt_update_4.html)*

Deconstruction of a WWII-era warehouse building at The Presidio of San Francisco, CA, 1996 *(See http://www.ciwmb.ca.gov/ConDemo/CaseStudies/Presidio/default.htm)*

Deconstruction of Riverdale Village apartments in Baltimore County, MD, 1997 *(See http://www.smartgrowth.org/pdf/deconstruction.pdf)*

Deconstruction of eight WWII-era buildings of various types at Fort Ord, CA, 1997 *(See http://www.fora.org)*

Deconstruction of two WWII-era industrial buildings at Alameda Naval Air Station, CA, 1997 *(See http://www.conversion.org/cec/dsrr.pdf)*

Deconstruction of Stowe Village apartment units in Hartford CT, 1998 *(See http://www.ilsr.org/recycling/deconatwork.html)*

Deconstruction of ten houses in Gainesville FL, 1999-2000 *(See http://www.cce.ufl.edu/past/deconstruction/reuse.html)*

Positive results have been achieved in these and other deconstruction projects. Recovering 50% to over 90% of the building's materials for reuse or recycling has been recorded. It was acknowledged that deconstruction took considerably longer than simple demolition, thereby increasing initial cost. Based on case study data deconstruction progressed at the rate of roughly 3 - 5 square feet of building per labor-hour. The cost to manually deconstruct a wood frame building was in the range $5-$6/SF, compared to roughly $3/SF for conventional demolition. However, higher initial costs were offset by savings in debris disposal and the resale value of the recovered materials. The net cost of deconstruction was documented at anywhere between $0.12 - $2.28/SF lower than conventional demolition, hauling, and landfilling costs. None of these case studies indicated a net income, where the value of the materials exceeded the cost of deconstruction.

From a contractor's perspective, the additional costs involved in deconstructing buildings and processing the materials are offset by the value of the materials and costs avoided by reducing the volume of debris to be disposed of. A rule of thumb is that selling recovered materials to a used building materials outlet will

yield roughly 25% of the retail value of comparable new materials. If a contractor sold these materials directly, a value of roughly 50% of the retail value of comparable new materials would be reasonable. Alternatively, a contractor can donate materials to a non-profit organization. The contractor then incorporates this donation into the company's income tax calculation. The recipient organization may inventory the materials and assign values, per their own selling price or may simply inventory the donated materials and issue a receipt, whereby the contractor would assign a value. Cost avoidance or savings accrue from reduced hauling and tipping expenses due to a reduced debris volume.

It must be noted that some criticism has been leveled at these case studies. Each has been conducted on a pilot or trial basis, several funded from one-time grants, and several utilizing a non-traditional workforce, such as at-risk youth training for construction trades. Their pay was not always comparable to prevailing scale. Furthermore, the estimated value of recovered materials was sometimes used to calculate cost offset, as opposed to actual resale price. Some argue, therefore, that actual costs will be higher and resale values will be lower if deconstruction were conducted on an ongoing commercial basis.

Whether the net cost of deconstruction is actually less than demolition is still somewhat speculative. If deconstruction is performed on a more routine, commercial basis, methods will certainly evolve to improve cost and time performance. The demand for used building materials, and therefore their economic value, have not yet reached the point where landfilling materials as debris is an uneconomical practice. While landfill tipping fees are increasing in some areas of the U.S., it is still an acceptable price for building removal services. The expense is still not great enough to force a dramatic change in practice. However, all indications are that deconstruction can at least be competitive with conventional demolition practices, if all costs and offsets are considered.

There are three noteworthy examples of deconstruction are evident within the Army. Each of these installations have developed methods to remove surplus buildings while at the same time providing resources and opportunities to their communities.

Fort McCoy, WI advertises surplus buildings for public bid and sells them to the highest bidder. Individuals or small contractors deconstruct the buildings to the foundation. Fort McCoy removes the concrete and turns it over to Engineering Battalions, which grind it and use it on-post. Over the last ten years, Fort McCoy has removed over 140 buildings, and estimates that they have saved over $3.5 million.

Fort Knox conducts a similar process, although bids are solicited through live auction. Fort Knox has disposed of 285 buildings over the last three years, which

has generated over $250,000 in income (through their recycle program), and saved roughly $640,000 in demolition cost avoidance.

There are many examples of deconstruction being as a successful commercial venture. However, deconstruction must still be considered an emerging practice within the building industry. Commercial services are available to deconstruct buildings. There are commercial and non-profit outlets through which salvaged building materials can be sold. There are material exchanges (many through public agencies) where salvaged materials can be traded. However, deconstruction is still very much a "cottage industry" with overall limited capabilities and resources, at least compared to the demolition industry. The Used Building Materials Association does provide an industry forum for those engaged in materials' recovery and reuse. *(See http:// www.ubma.com)* The Reuse Development Organization provides a national clearinghouse for marketing and reusing products and materials, used building materials being one of their interests. *(See http://www.redo.org)*

A discussion of "deconstruction" however, must not be confined to the physical activities of disassembling a building. Disposition of the recovered materials – resale, reuse or recycling -- is critical. Without an outlet for the recovered or recycled materials, deconstruction is a pointless endeavor. Therefore, the availability of used building materials' markets, and economic benefit of recovery and marketing, are equally important considerations as the deconstruction process itself.

In summary, "deconstruction" has not yet entered the mainstream of building removal practices. Awareness within the construction industry and public at large is still quite low. The relative economics of deconstructing buildings appears to be favorable, even compared to demolition and landfilling as the default methods of building disposal. However, public and industry awareness of deconstruction as a viable alternative must still improve. Solid waste problems, pressure on landfill capacity, and increasing cost of debris disposal are certain to improve the visibility of deconstruction as a viable method to remove buildings.

Potential for Deconstructing Army Buildings.

In January 2001, the National Association of Homebuilders Research Center authored "A Report on the Feasibility of Deconstruction" for the U.S. Department of Housing and Urban Development. This report describes deconstruction activities taking place in four U.S. metropolitan areas and summarizes conditions and factors that effect the viability of deconstruction as an ongoing commercial practice.

In this report, an opinion is offered that military installations provide a greater potential for structural deconstruction (i.e. removing the whole building) than metropolitan areas in general. To paraphrase, the rational is:

Redevelopment pressures are greater within the metropolitan area, thus reducing the time and opportunity for extensive disassembly and recovery.

The numbers and uniformity of building types on a military installation can provide the consistency and volume of building materials needed to sustain a used building materials market.

Prevailing housing conditions and policy within metropolitan areas will have a lesser impact on military base deconstruction.

When taken in the context of surplus WWII wood buildings, it is evident that military installations provide a greater potential for successful deconstruction than the community at large. While there are pressures on building sites within an Army installation, they are not always as inhibiting to deconstruction as they may be in the commercial building market. To sustain a deconstruction practice in the private market, the deconstructors must conclude arrangements with individual property owners, one at a time, on an ongoing basis. However, there is essentially one property owner on a military installation. Policy or practice can (at least in theory) be implemented in an expedient manner. Securing the endorsement of the Installation or Garrison Commander will help in implementing a deconstruction program involving hundreds of buildings.

Army wide, the potential for deconstruction is enormous. Lumber is the predominant building material in WWII buildings. Observation at several Army installations suggests most WWII buildings are in reasonably good condition, even though they may appear somewhat rundown. Unless a building has been damaged or seriously neglected, and has deteriorated, most lumber and building components should be recoverable.

Buildings that were originally built as barracks, administrative facilities, mess halls, recreation buildings, medical buildings, etc. were generally framed with two-by dimensional lumber framing (i.e. 2” x 4” through 2” x 12” members). Wall and roof sheathing was typically one-inch board. Vehicle maintenance shops and warehouses utilize some heavier lumber (three-by, such as 3”x8” members) in framing, especially with long span roof framing assemblies. Some timber framing (4-inches and heavier) is used in industrial-type buildings.

ERDC / CERL conservatively estimates the quantity of lumber that can be recovered and reused from a typical WWII wood building to be 4 board feet (BF) of lumber per square foot (SF) of building. Given that there are roughly 30 million SF of WWII buildings to be removed, over 120 MILLION BF of lumber could potentially be harvested from Army buildings for reuse. This figure does NOT include the painted wood siding, which is discussed below. Other recoverable materials include the following:

Tongue and groove flooring is found on most installations. It is mostly pine, although oak flooring is sometimes present.

The original windows were predominantly six-over-six double hung style. Original doors are typically five-panel interior doors, and four-panel exterior doors with vision panels. If these remain intact and are in reasonably good condition, they should be marketable. See the discussion below on lead-based paint.

Replacement windows are typically factory finished aluminum, double glazed, double hung windows. Vinyl windows are frequently present. Replacement doors are typically steel exterior doors and solid core interior doors. Replacement hardware is typically commercial grade. These items should be marketable, especially if keys accompany the locksets.

Vinyl siding may be marketable or recyclable. However, outlets will not be available in all locations.

Asphalt shingle roofing can be recycled in some locations. Recycled roofing debris is typically incorporated into new paving materials.

Metals from roof vents, flashings, and other miscellaneous fabrications can be recycled.

Many of these building types were originally heated with their own boilers, which were vented by brick chimneys. Used bricks are marketable in most locations.

Recently installed acoustic ceiling systems are reusable, although these materials may not have much monetary value.

Buildings that have recently been renovated may have furnaces, heat pumps, air handling units, water heaters, plumbing fixtures, electrical distribution equipment (load centers, circuit breaker boxes), and lighting fixtures that can be marketed through used building materials outlets. These buildings are rarely air conditioned, so there would typically be no compressor units or chillers to either resell or dispose.

Piping, ductwork, boilers, hot water tanks, and other metals can be recycled, although scrap values are quite low at present. Copper wiring can also be sold as scrap in many locations.

Generally, WWII-era buildings were built with old-growth lumber, which is denser, with tighter rings, than comparable species harvested from today's second or third generation forests. Siding was generally of a higher grade than framing lumber. Similar lumber is frequently reprocessed into architectural millwork,

commanding a higher price than used framing lumber. The reason for this is that old lumber can provide an appearance when finished that new lumber cannot. Some species, such as old growth long leaf pine, can command much higher prices than similar new lumber.

The effort required to obtain these materials must also be considered. Roofing, exterior finishes, and interior finishes must be removed in order to remove the framing lumber, and must be removed in such a fashion as to not damage the lumber.

The ideal situation for deconstruction would be a building with little or no interior partitioning, exposed framing on the interior, and only the original wood siding on the exterior. However, as these buildings have been occupied since the end of WWII, their occupancy and configuration has evolved according to the requirements of the installation and the buildings' tenants. The most common adaptation of WWII barracks, administrative buildings, dining halls, recreation buildings, and similar lumber-framed buildings was to install partitions to make separate rooms, and finish interior surfaces. Thus, gypsum wall board and/or paneling now cover most interior wall and ceiling surfaces, and multiple layers of flooring and underlayment cover the floor. Asphalt roofing can be recycled in some locations, although shingles are most commonly discarded as debris. Fortunately, multiple layers of roofing have not been observed on WWII-era buildings; the typical practice is to tear-off old shingles prior to installing new paper and shingles. Low-slope roofs on some warehouse designs have been roofed with various types of membrane roofing, which is difficult to remove if it is fully adhered. As these materials have no value, their removal represents all cost with no economic return.

The Army, at least in some quarters, has begun to recognize the potential for disposing of surplus buildings in a more useful manner than landfilling. The Principal Deputy Assistant Secretary of the Army (PDASA) has entered into discussions with Habitat for Humanity and other Federal agencies (including HUD and EPA) to develop less expensive and less wasteful avenues of disposing of surplus buildings by moving them off installations, or deconstructing them to salvage building materials for reuse. The PDASA has committed the Army to supporting initiatives whereby the Army and surrounding communities can benefit from the reuse of excess Army buildings. Furthermore, the PDASA directs ERDC / CERL to work cooperatively with EPA and other organizations to develop deconstruction and reuse technologies.

The Assistant Chief of Staff for Installations and Management (ACSIM) has issued a memorandum providing guidance for management of solid waste generated by construction and demolition (C&D) activities. It describes the objective of C&D waste management "…to ensure that materials removed from demolished structures and waste materials generated during new construction

are either salvaged for resale, reused on site, or recycled in lieu of being disposed of in a landfill or incinerated, when economically feasible. “

Unified Federal Guide Specifications are now being utilized by the Corps of Engineers to replace the Corps of Engineers Guide Specifications. UFGS are mandatory for appropriated Military Construction projects, which are managed by the Corps of Engineers. UFGS are not mandatory for installations’ use, although they are frequently edited or adapted and incorporated into installations’ contract documents. UFGS 01571, Construction and Demolition Waste Management, and 02220, Demolition, both state that materials and debris shall be salvaged for recycling or reuse to the maximum extent possible. However, no specific criteria for waste diversion is given, and actual jobsite practice may be questionable.

In summary, there is a significant resource available in surplus Army buildings. There is an awareness of the potential benefits of salvaging or recycling materials from surplus buildings, if for nothing else to keep them from consuming diminishing landfill capacity. The challenge is being able to capitalize on this potential in routine practice.

Obstacles to Deconstructing Army Buildings.

Two installations maintain active deconstruction programs for removing surplus WWII buildings currently, and a third is initiating deconstruction on a pilot basis. Thus, deconstruction is possible within the Army environment. There are, however, several factors that make deconstruction more difficult on Army installations, or at least compared to traditional demolition and landfilling practices. The following represent the primary reasons deconstruction is not practiced widely on Army installations.

General Practice.

The institutional paradigm is to *demolish* surplus buildings. While alternatives are possible, demolition with landfilling is the default solution to this requirement. Surplus buildings are perceived as a liability as opposed to a potential resource -- debris as opposed to building materials. Standard practice is the lowest risk course of action. The current system works well given current expectations, and there is little incentive to depart from standard practice.

A DPW or PWBC will include Real Property, Master Planning, Environmental, and Engineering Divisions (or similarly titled units) within its organization. While these Divisions work together in the building removal process, their objectives conflict to a great extent. For example, while free tipping reduces cost of construction and demolition activities, it discourages salvage and debris diversion. What is a desirable result from an engineering perspective creates the problem from an environmental perspective. Conversely, if Environmental

Division places constraints on tipping, the cost of construction and demolition services can increase.

Installation and Corps personnel usually express no fundamental objection to salvaging and re-using building materials. Most are quite receptive to the idea of recovering materials from a resource conservation viewpoint. However, they generally cannot visualize how this can be accomplished within current installation practices.

In summary, the current practice responds to requirements, at least as currently defined, and is the path of least resistance for installation personnel. Any practice outside of the mainstream necessitates greater effort to implement.

Non-familiarity with the Market.

Engineering personnel at the installations and Corps Districts are well attuned to traditional construction services and capabilities in their locale. They are much less familiar with the local capabilities for deconstruction, building materials' recovery and salvage, and materials' resale or reuse.

Deconstruction and salvage contractors are generally quite small firms. They typically do not peruse the media in which Army projects are advertised. They typically do not engage in public projects where an extremely formal contracting environment is in place. Non-traditional services, such as Habitat for Humanity are not organized the same way as commercial contractors. They must typically assemble resources on a job-by-job basis, and may be unable to respond to formal solicitations within the time required.

Installation personnel are also generally not aware of the used building materials marketplace or values. Such information is not represented in any Army guidance media or data. The potential value of a surplus wood frame building, or potential outlets for recovered materials, are essentially unknown.

While deconstruction capabilities may exist in an installation's locale, they are generally unknown to installation personnel. And as demolition is the default method for removing buildings, there is little reason for installations to try to attract these services.

Economic Factors.

Lowest first cost drives building removal practice. Demolition of wood-frame buildings is still relatively inexpensive, especially when contractors are allowed to tip debris into installations' landfills at no cost to themselves. The rationale behind free tipping is to reduce the cost of demolition, or reduce the contract price for construction projects that include demolition activities. This is an appropriate practice from the perspective of managing contract costs. Requiring

a demolition contractor to deconstruct a building could increase first cost from roughly $2 to $3/SF to $4 or $5/SF.

The emphasis of lowest first cost also ignores the other costs to the Government that are outside the initial contract or task scope. Landfill life cycle costs (construction or expansion, permitting, management, closure, and monitoring) are estimated to cost an additional $30-50 / ton of debris.

There are other issues of cost avoidance or cost offset associated with deconstruction that are not reflected in the low-first-cost paradigm. Diverting debris reduces hauling costs. The value of recovered materials offsets the initial cost of extraction. In a competitive environment these factors could, theoretically, result in lower prices for building removal services. However, these factors are not incorporated in the current pricing scheme. In a JOC arrangement, unit prices for demolition are fixed. A contractor will be paid the same per square foot of building regardless of the amount of debris generated or diverted. In a new construction project, demolition activities have a very low sensitivity in the total construction contract cost. Even a dramatic difference in demolition cost will usually alter the total contract cost by a percent or less. Therefore, little emphasis on innovation or economy is justified on the part of the General Contractor. It is unusual that a demolition contract will be advertised as a stand-alone contract (as opposed to a JOC task). Even if this were to happen, other constraints could prevent the contractor from engaging in extensive material recovery (see below).

The applicability of the Davis-Bacon Act to deconstruction has been questioned. Briefly, Davis-Bacon requires that labor for Federal construction projects is paid at the wage scale prevailing in the project's locale. If all labor were to be paid Davis-Bacon wages, deconstruction would be extremely expensive compared to traditional demolition. Application of Davis-Bacon would virtually preclude participation by non-traditional service organizations, such as HfH or National Civilian Conservation Corps. However, per Department of Labor and ERDC's Vicksburg Construction Branch - Deconstruction (no new construction following the deconstruction) is not subject to the Davis-Bacon Act. It is considered a "service" and therefore the Service Contract Act and applicable wage determinations would apply.

Scheduling.

Manual deconstruction takes considerably longer than conventional demolition: "weeks" as opposed to "days" for a typical WWII-era barracks building. Combining mechanical methods with manual deconstruction can reduce deconstruction time. However, deconstruction will almost always take longer than simple demolition.

In a Facility Reduction scenario, a longer deconstruction duration is generally not an obstacle. Schedule problems are due more to the overall processes preceding demolition or deconstruction than the deconstruction activities themselves. There may be no specific deadline by which a given building must be vacated and demolished. However, once a building is cleared for demolition, the installation will generally not let it remain standing vacant for long periods of time.

As described above, an installation can initiate a demolition task on a JOC in a relatively short time. If a deconstruction alternative were considered, it would take considerably longer to advertise and award a contract. Furthermore, it would be difficult for non-traditional services, such as Habitat for Humanity, to coordinate resources within a typical advertisement and bidding timeframe.

In a new construction scenario, building demolition becomes critical to the project schedule. Demolition is one of the first activities on the critical path, and a protracted demolition duration is intolerable. To the General Contractor, the value of time exceeds the monetary value of materials that may be salvaged. Thus, the requirement to clear the site usually prevents any significant salvage or deconstruction efforts.

Contracting.

Public contracting policy and practice are based on maximizing competition and equity among all competitors. However, the practices applied to removing WWII-era buildings de-facto discourages deconstruction. Several factors contribute.

Contracts are typically awarded to the lowest-priced, responsible bidder. The discussion of economic factors, above, describes how this method cannot account for any economic benefits associated with deconstruction. Therefore, deconstruction is seen as being “uneconomical” from a low-first-cost perspective.

The contract mechanism most frequently used in building removal situations is a JOC, as described above. The JOC program typically attracts contractors who perform a variety of services, and who are familiar with JOC processes. Firms that engage in deconstruction as a specialty, or as part of a larger demolition service, typically do not participate in public projects involving more formal, rigorous contract requirements.

Only contractors currently under a JOC perform demolition activities. Therefore, it is difficult to introduce alternative services and resources to demolition requirements. Deconstruction can certainly be performed outside of a JOC. However, initiating independent contract actions is more cumbersome to the installation.

Retaining non-traditional services such as HfH is possible, but would require a contract or agreement that is not typically applied to demolition services. Competitive bidding would be impractical. Sole source selection is possible, but would involve a Justification and Authorization exercise that is not required with competitive bidding.

Under a JOC, unit prices for demolition are established in a Unit Price Book. A JOC contractor will be paid the same per square foot of building whether it is disassembled or crushed it with a track hoe. Therefore, as long as the JOC is in effect, a contractor has no incentive to invest more than the minimum resources required to remove the building.

The greatest obstacle to deconstruction, however, appears to be the prohibition on removing materials from the installation, thus preventing salvage and resale. Clauses frequently appear in Contract Conditions and in Technical Specifications that require ALL building debris to be deposited in the installation's landfill. The rationale appears to be twofold. First, a contractor is being paid to demolish a building and dispose of the debris. Some argue that it somehow improper for contractor to accrue any further benefits by re-selling salvaged materials, i.e. "double dipping." Second, installations are extremely risk adverse, and are reluctant to expose themselves to liability in the event that someone suffers injury or hazard to health because of materials obtained from an Army installation. ERDC / CERL has found no explicit prohibition in statute or regulation on removing materials from an installation. However, this is still widely accepted as standard practice.

Real Property Transfer.

The ownership of a building in a deconstruction scenario is not always clear. If all debris is to be deposited in an installation's landfill, the issue of ownership or salvage rights is a moot point. However, if a party deconstructs a building and remove materials for resale, ownership becomes more clouded. AR 405-90 requires that surplus property that has a value must be sold. Surplus property with no value must be discarded. The question is raised – if a building has value enough for a party to salvage materials, why doesn't the Army sell it, rather than pay for deconstruction services? One interpretation is that the Army (i.e., the using service) has the opportunity to take everything in the building that is of value to them, and what remains has no value to the Army. Another interpretation is that the Installation Commander and Corps District can determine that deconstruction and salvage is an appropriate course of action, and can authorize this approach. Interpretations will differ among installations.

It must be noted, however, that UFGS 02220 includes language that allows salvage to the maximum extent possible, and gives title to materials to the Contractor. Other UFGS for C&D Waste Management and Recycling include similar language.

AR 405-90 gives guidance on the Disposal of Real Estate. The Corps of Engineers has responsibility for disposing of Real Estate from active Army installations, whereas the GSA has that responsibility for "excess" facilities. Any "personal property" associated with a building is removed and recycled or reused by the DPW, or and last tenants. All unwanted personal property should be sold or disposed through the local Defense Reutilization and Marketing Office (DRMO).

Lead-Based Paint.

The presence of lead-based paint (LBP) on WWII-era buildings is the most frequently cited reason for not salvaging the materials. Uncertainty about regulatory constraints and liability concerns are the two primary contributing factors.

Painted materials are considered by many in the Army to be "hazardous" – but in the general definition of the term. Building debris is not classified as hazardous by states' regulations, and used building materials with LBP do not fall under the Resource Conservation and Recovery Act (RCRA) waste regulations. Installations are still reluctant to allow painted exterior siding and other wood materials to leave the installation. The major concern is that the Army will be held liable for any harm suffered as a result of the subsequent use of these materials.

Used building materials' outlets, both commercial and non-profit, commonly sell painted items. Where the presence of LBP is known or suspected, a disclosure statement is issued. Fort McCoy, Fort Knox, and Fort Campbell include LBP disclosures in their deconstruction solicitations. There is still a perception, however, that simply disclosing the presence of LBP does not relieve the Army of liability. There are also concerns about occupational hazards associated with removal and handling of painted items.

There is a great deal of uncertainty about the paint's behavior in buildings. Some within the Army suggest that even unpainted materials become contaminated through lead in dust, foot traffic, and other avenues of contamination.

ERDC/CERL, in coordination with their research partners is currently working to understand how LPB interacts with wood surface, and investigating efficient methods for removing and disposing of LBP residue.

Conclusions and Recommendations.

Deconstruction is emerging as a viable alternative to demolishing buildings and landfilling the debris. The economics of this practice vary considerably depending on the property's owner, project or program objectives, who is

performing the deconstruction services, how the project is financed, local economic conditions, and other factors. However, current practice suggests that deconstruction can be a cost-effective and practical method to remove buildings.

The Army has yet to practice deconstruction routinely. As a "corporate" organization, the Army has established a set of procedures that respond to its building removal requirements. Standard practice works well – at least to remove buildings.

Deconstructing surplus WWII-era buildings is not entirely consistent with the Army's standard demolition practices. However, deconstruction is not impossible. Examples exist within the Army environment to show how deconstruction can be implemented. While it is the exception rather than the rule, these examples show that obstacles are not insurmountable.

The following measures would have to take place to enable installations to implement deconstruction on a routine basis. While some imply a departure from standard practice, all should achievable within the Army environment. Furthermore, increased emphasis on environmental sustainability by the Army at all levels from Headquarters to installations should provide a justification and the incentive to accommodate deconstruction.

Note that these are described in only general terms and have not been endorsed or adopted as policy at any Army level. However, they do represent avenues that can be pursued within the practical confines of installations' routine business.

> Identify and promote the value of surplus WWII buildings in terms of salvaged materials, the burdens placed on the installation by the debris stream, and the life-cycle expenses of landfilling debris.
>
> Acknowledge all economic factors effected by demolition and landfilling when assessing the economic feasibility of deconstruction. These include the initial cost of removing the buildings, offsets to initial costs from resale revenues, cost avoidance, and life cycle costs invested in landfill operation and management.
>
> Identify the salvage and deconstruction capabilities within the installation's locale. These may include commercial deconstruction or salvage companies, demolition contractors that specialize in salvage, used building materials outlets, commercial C&D debris recycling firms, used materials exchanges, trade organizations, and non-traditional services such as Habitat for Humanity. Monitor used building material and scrap markets in the region.

Inform the salvage, deconstruction, and recycling services of the Installation's building removal requirements, and encourage participation in projects.

Adjust demolition schedules to accommodate alternative methods of removing buildings. "Package" buildings into contracts of sufficient scope to attract participants with the required deconstruction, salvage, or recycling services, or non-traditional services to assemble the required resources. This may be 8-12 buildings or more.

Allow sufficient time in the procurement schedule to publicize and encourage participation by capable contractors and services who do not ordinarily participate in Army or Federal contracts.

Allow sufficient time to deconstruct the buildings, salvage and recycle debris, or at least perform extensive salvage prior to demolition. If demolition would be included with a new construction contract, consider removing the building independently of the new construction contract, and far enough in advance to enable the site to be cleared, and not delay construction activities.

Do not require that all non-hazardous demolition debris be deposited in the installation's landfill. Transfer title to the contractors and allow them the opportunity to recover or salvage materials for reuse or recycling. Allow savings to accrue to the contractor as an incentive to divert waste.

Where it is impractical to recover materials such as concrete or reuse, develop uses for recycled products such as rubble, erosion control, or fill on the Installation.

Points of Contact.

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